

AD-A209 426

**AFOEHL REPORT
89-036EH0100EEF**



Field Evaluation of Direct-Reading Continuous Ethylene Oxide Monitors

**MOHAMMAD A. HOSSAIN, Maj, USAF, BSC
DAVID R. CARPENTER, Capt, USAF, BSC**

May 1989

Final Report

**DTIC
ELECTE
JUN 20 1989
S E D**

Distribution is unlimited; approved for public release

**AF Occupational and Environmental Health Laboratory
Human Systems Division (AFSC)
Brooks Air Force Base, Texas 78235-5501**

89 6 19 094

NOTICES

When Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated, or in any way supplied the drawing, specifications, or other data, is not to be regarded by implication, or otherwise, as in any manner licensing the holder or any other person or corporation; or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The mention of trade names or commercial products in this publication is for illustration purposes and does not constitute endorsement or recommendation for use by the United States Air Force.

The Public Affairs Office has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nations.

This report has been reviewed and is approved for publication.



MOHAMMAD A. HOSSAIN, Major, USAF, BSC
Chief, Exposure Assessment Function



DENNIS R. SKALKA, Lt Col, USAF, BSC
Chief, Consultant Services Division

Air Force installations may direct requests for copies of this report to:
USAF Occupational and Environmental Health Laboratory (AFOEHL) Library, Brooks
AFB TX 78235-5501.

Other Government agencies and their contractors registered with the DTIC
should direct requests for copies of this report to: Defense Technical
Information Center (DTIC), Cameron Station, Alexandria VA 22304-6145.

Non-Government agencies may purchase copies of this report from: National
Technical Information Service (NTIS), 5285 Port Royal Road, Springfield VA
22161



JAMES C. ROCK, Colonel, USAF, BSC
Commander

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS NA	
2a. SECURITY CLASSIFICATION AUTHORITY NA			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE NA				
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 89-036EH0100EEJ			5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION AF Occupational and Environmental Health Laboratory		6b. OFFICE SYMBOL (If applicable) ECH	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) Brooks AFB TX 78235-5501			7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Same as 6a		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS	
			PROGRAM ELEMENT NO.	PROJECT NO.
			TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Field Evaluation of Direct-Reading Continuous Ethylene Oxide Monitors				
12. PERSONAL AUTHOR(S) Hossain, Mohammad A., Maj, USAF, BSC and Carpenter, David R., Capt, USAF, BSC				
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM _____		14. DATE OF REPORT (Year, Month, Day) May 1989
15. PAGE COUNT 9				
16. SUPPLEMENTARY NOTATION				
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	Central Sterile Supply (CSC) Ethylene Oxide (EtO) Charcoal Tubes Field Evaluation Direct-Reading EtO Monitors Parts per Million (ppm)	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)				
<p>The Wilford Hall USAF Medical Center Central Processing Section (WHMC/SGLP) requested AFOEHL perform a field evaluation of two direct-reading continuous ethylene oxide (EtO) monitors. The objective of this evaluation was to conduct a field study to compare the performances of AMSCO's Envirogard III and Baseline Industries, Inc.'s Model 5500 Gas Analyzer against the Occupational Safety and Health Administration's (OSHA) acceptable charcoal tube sampling method. In addition, the 3M EtO passive monitor sampling method was compared with the charcoal tube method and direct-reading instrumental method as well.</p>				
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Mohammad A. Hossain, Maj, USAF, BSC			22b. TELEPHONE (Include Area Code) (512) 536-3214	22c. OFFICE SYMBOL AFOEHL/ECH

INSTRUCTIONS FOR PREPARATION OF REPORT DOCUMENTATION PAGE

GENERAL INFORMATION

The accuracy and completeness of all information provided in the DD Form 1473, especially classification and distribution limitation markings, are the responsibility of the authoring or monitoring DoD activity.

Because the data input on this form will be what others will retrieve from DTIC's bibliographic data base or may determine how the document can be accessed by future users, care should be taken to have the form completed by knowledgeable personnel. For better communication and to facilitate more complete and accurate input from the originators of the form to those processing the data, space has been provided in Block 22 for the name, telephone number, and office symbol of the DoD person responsible for the input cited on the form.

All information on the DD Form 1473 should be typed.

Only information appearing on or in the report, or applying specifically to the report in hand, should be reported. If there is any doubt, the block should be left blank.

Some of the information on the forms (e.g., title, abstract) will be machine indexed. The terminology used should describe the content of the report or identify it as precisely as possible for future identification and retrieval.

NOTE: Unclassified abstracts and titles describing classified documents may appear separately from the documents in an unclassified context, e.g., in DTIC announcement bulletins and bibliographies. This must be considered in the preparation and marking of unclassified abstracts and titles.

The Defense Technical Information Center (DTIC) is ready to offer assistance to anyone who needs and requests it. Call Data Base Input Division, Autovon 284-7044 or Commercial (202) 274-7044.

SECURITY CLASSIFICATION OF THE FORM

In accordance with DoD 5200.1-R, Information Security Program Regulation, Chapter IV Section 2, paragraph 4-200, classification markings are to be stamped, printed, or written at the top and bottom of the form in capital letters that are larger than those used in the text of the document. See also DoD 5220.22-M, Industrial Security Manual for Safeguarding Classified Information, Section II, paragraph 11a(2). This form should be unclassified, if possible.

SPECIFIC BLOCKS

Block 1a. Report Security Classification: Designate the highest security classification of the report. (See DoD 5220.1-R, Chapters I, IV, VII, XI, Appendix A.)

Block 1b. Restricted Marking: Enter the restricted marking or warning notice of the report (e.g., CNWDI, RD, NATO).

Block 2a. Security Classification Authority: Enter the commonly used markings in accordance with DoD 5200.1-R, Chapter IV, Section 4, paragraph 4-400 and 4-402. Indicate classification authority.

Block 2b. Declassification / Downgrading Schedule: Indicate specific date or event for declassification or the notation, "Originating Agency Determination Required" or "OADR." Also insert (when applicable) downgrade to _____ (e.g., Downgrade to Confidential on 6 July 1983). (See also DoD 5220.22-M, Industrial Security Manual for Safeguarding Classified Information, Appendix II)

NOTE: Entry must be made in Blocks 2a and 2b except when the original report is unclassified and has never been upgraded.

Block 3. Distribution/Availability Statement of Report: Insert the statement as it appears on the report. If a limited distribution statement is used, the reason must be one of those given by DoD Directive 5200.20, Distribution Statements on Technical Documents, as supplemented by the 18 OCT 1983 SECDEF Memo, "Control of Unclassified Technology with Military Application." The Distribution Statement should provide for the broadest distribution possible within limits of security and controlling office limitations.

Block 4. Performing Organization Report Number(s): Enter the unique alphanumeric report number(s) assigned by the organization originating or generating the report from its research and whose name appears in Block 6. These numbers should be in accordance with ANSI STD 239 23-74, "American National Standard Technical Report Number." If the Performing Organization is also the Monitoring Agency, enter the report number in Block 4.

Block 5. Monitoring Organization Report Number(s): Enter the unique alphanumeric report number(s) assigned by the Monitoring Agency. This should be a number assigned by a DoD or other government agency and should be in accordance with ANSI STD 239 23-74. If the Monitoring Agency is the same as the Performing Organization, enter the report number in Block 4 and leave Block 5 blank.

Block 6a. Name of Performing Organization: For in-house reports, enter the name of the performing activity. For reports prepared under contract or grant, enter the contractor or the grantee who generated the report and identify the appropriate corporate division, school, laboratory, etc., of the author.

Block 6b. Office Symbol: Enter the office symbol of the Performing Organization

Block 6c. Address: Enter the address of the Performing Organization. List city, state, and ZIP code

Block 7a. Name of Monitoring Organization: This is the agency responsible for administering or monitoring a project, contract, or grant. If the monitor is also the Performing Organization, leave Block 7a. blank. In the case of joint sponsorship, the Monitoring Organization is determined by advance agreement. It can be either an office, a group, or a committee representing more than one activity, service, or agency.

Block 7b. Address: Enter the address of the Monitoring Organization. Include city, state, and ZIP code

Block 8a. Name of Funding/Sponsoring Organization: Enter the full official name of the organization under whose immediate funding the document was generated, whether the work was done in-house or by contract. If the Monitoring Organization is the same as the Funding Organization, leave 8a blank

Block 8b. Office Symbol: Enter the office symbol of the Funding/Sponsoring Organization

Block 8c. Address: Enter the address of the Funding/Sponsoring Organization. Include city, state and ZIP code

I. INTRODUCTION

The Wilford Hall USAF Medical Center Central Processing Section (WHMC/SGLP) uses ethylene oxide (EtO) as a primary sterilizing agent. Because of their concern about the health effects of EtO, SGLP has searched for a continuous monitoring EtO system. In their search, they found two units (AMSCO's Envirogard III and Baseline Industries, Inc.'s Model 5500 Gas Analyzer) which were demonstrated during January and February 1989 for one week each in the sterilization area. To help determine if the continuous monitors were accurate, in January 1989 SGLP requested AF Occupational and Environmental Health Laboratory (AFOEHL) perform an evaluation of the two monitors.

A. Background: In September 1988 HQ USAF/SGPA requested HQ AFSC/SGPB task AFOEHL to evaluate AMSCO Envirogard III and other available instrumentation capable of warning central sterile supply (CSS) personnel of hazardous concentrations of EtO in the event of a sterilizer malfunction or a cylinder leak. In response to this tasking, AFOEHL contacted several instrumentation manufacturers including AMSCO and Baseline Industries, Inc. and obtained equipment specifications. A review of the specifications was made and an evaluation was completed.(1) However, this evaluation did not include actual field testing of the EtO monitors.

B. Objective: The objective of this evaluation was to conduct a field study to compare the performances of the two direct-reading continuous EtO monitors against the Occupational Safety and Health Administration's (OSHA) acceptable charcoal tube sampling method. In addition, the 3M EtO passive monitor sampling method was compared with the charcoal tube method and direct-reading instrumental method as well.

C. Survey Personnel:

Major Mohammad A. Hossain
Capt David R. Carpenter
MSgt Abel B. de la Rosa
SSgt Pietro La Porta

D. Personnel Contacted:

Colonel Darla Soeder, Head of Operating Room, WHMC
Ms Josephine J. Anderson, Supervisor, Central Processing, WHMC
Mr Hank Braly, Baseline Industries, Inc. Representative
Mr Don Bebell, AMSCO Representative



By _____	
Distribution/ _____	
Availability Codes	
Dist	Avail and/or Special
A-1	

II. METHOD AND RESULTS

A. Survey Procedure: Demonstrations of the two direct-reading continuous EtO monitors (Baseline Industries, Inc. and AMSCO) were arranged by SGLP. Both instruments were designed to continuously monitor EtO concentrations from four separate locations using a gas chromatography/photoionization detection (GC/PID) system and were capable of providing printout data showing date, time, preset alarm level, actual concentrations, and a time-weighted average (TWA). The demonstration for each instrument was held separately; however,

the same sampling location was used for both monitors. Both instruments were temporarily installed for one week (AMSCO's Envirogard III in January and Baseline Industries Inc.'s Gas Analyzer in February) in the sterilization area. During the test only one sample point, in the mechanical room between the two EtO sterilizers, was continuously monitored by the instrument while simultaneous air sampling was conducted at the same location using charcoal tubes and 3M ethylene oxide monitors. For each instrument the test was conducted for only one day during the second shift. The charcoal tube sampling was accomplished by connecting two tubes in series in which the sampling rate was maintained at approximately 50 cubic centimeter per minute (cc/min). A record of the continuous monitor readings were obtained for the same time period as the air samples.

B. Analytical Methods: The samples collected during the test were analyzed by the Analytical Services Division of the AFOEHL. The charcoal tube samples were analyzed in accordance with the NIOSH Method 1607(2) and the 3M EtO monitors with the method developed by 3M Company, similar to NIOSH method 1614(3).

C. Results:

1. Since both instruments were demonstrated at different times, a direct comparison between the two continuous monitors was not possible. A comparison could be made between each instrument's response with the OSHA acceptable sampling method (charcoal tube) as well as the 3M EtO passive monitors performed during the test.

2. Figures I and II are graphs of the AMSCO and Baseline Industries, Inc. continuous monitor responses. These figures also show the corresponding time intervals during which we collected air samples. The Table summarizes the test results. For each air sample taken the corresponding average monitor response was calculated.

cont'g III. CONCLUSIONS

A. Neither the Baseline Industries, Inc. nor the AMSCO continuous monitors corresponded to OSHA acceptable charcoal tube method of air sampling. Both instruments reported EtO concentrations much higher than those detected by the charcoal tubes. In only one instance did the continuous monitor, AMSCO, report a level less than the charcoal tube method. In this case, while the AMSCO monitor showed no response, the charcoal tube as well as the 3M EtO passive monitor reported a TWA concentration of 0.5 ppm.

B. The results indicated that any interferences with the detection system would be a positive error. Thus, the actual level of EtO would always be equal to or less than the continuous monitor reading.

C. A good correlation between the 3M EtO passive monitor and charcoal tube sampling methods was established.

D. There is no way of knowing which method, the direct-reading continuous monitor or the charcoal tube/passive monitor, is more correct. However, the OSHA standard for EtO is based on measuring EtO by the charcoal tube method.

Keywords: Air Pollution, Industrial Medicine

AMSCO Ethylene Oxide Monitor Results

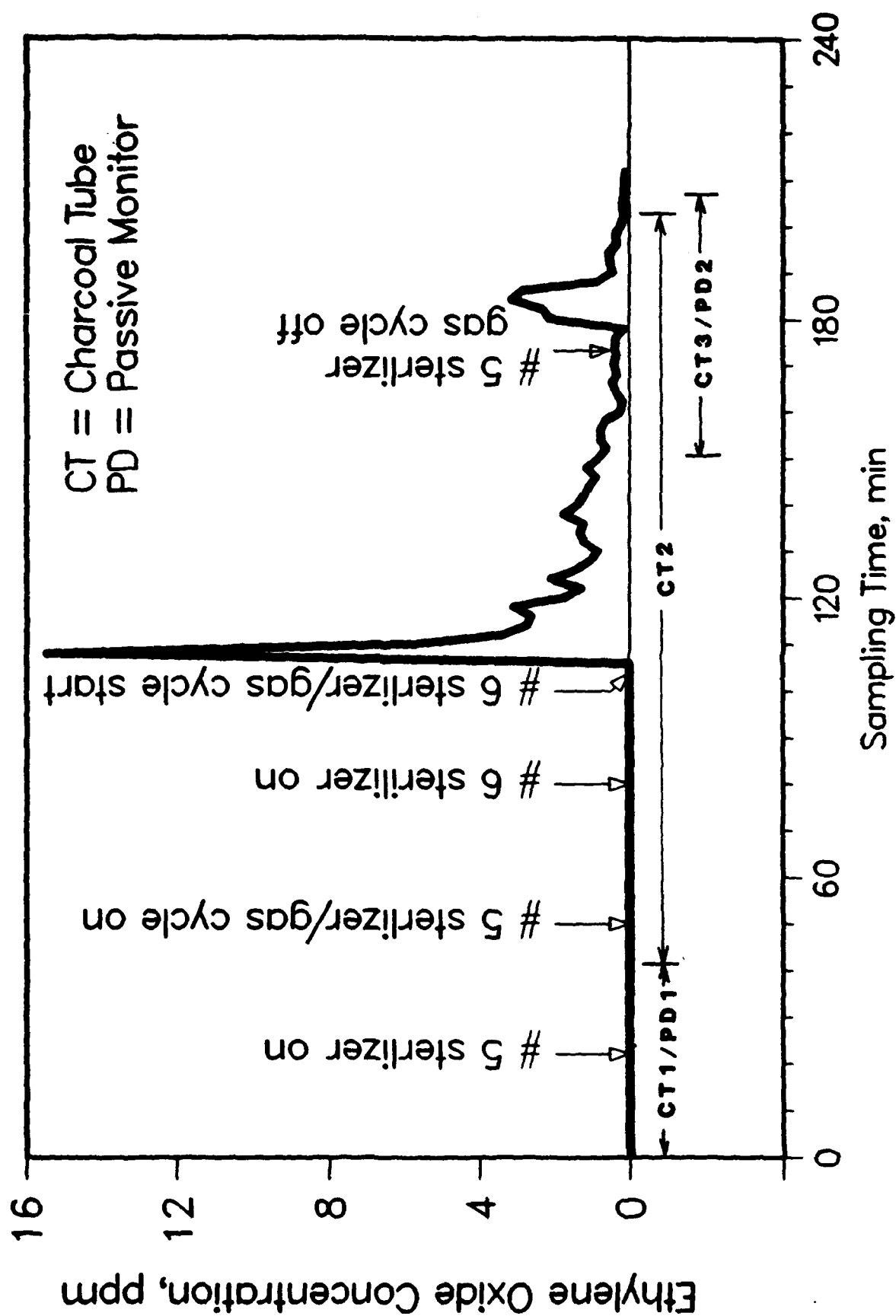


FIGURE 1.

Baseline Industries, Ethylene Oxide Monitor Results

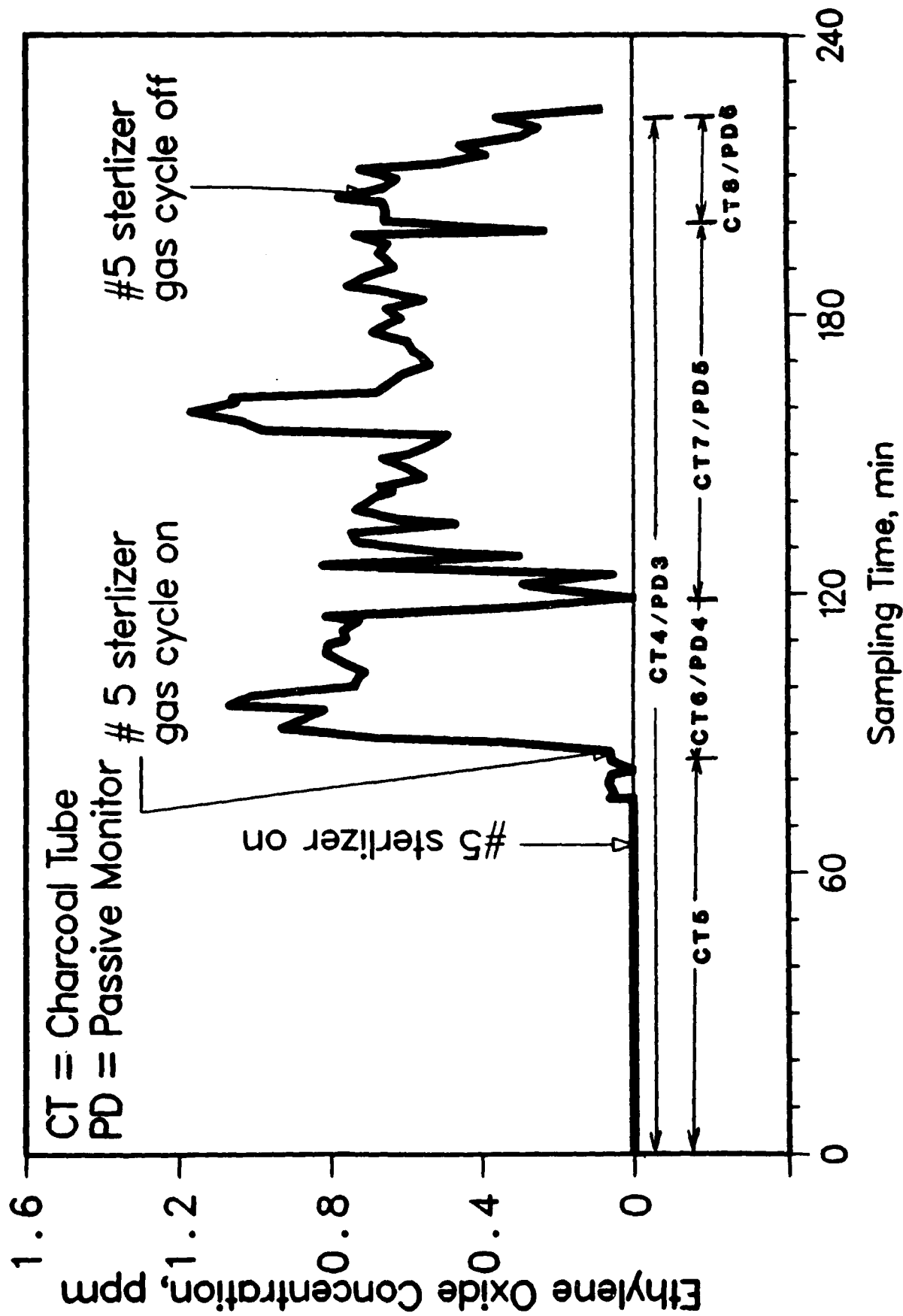


FIGURE 2

**Comparison of Charcoal Tubes & 3M Passive Monitors Sampling Methods
With Direct Reading Ethylene Oxide (EtO) Monitors**

Sampling Time, Min	Time-Weighted Average (TWA) Concentrations, ppm		
	@EtO Monitors	*Charcoal Tubes	**3M Passive Monitors
40	A: ND	CT1: 0.5	PD1: 0.5
160	A: 0.93	CT2: ND (<0.013)	NS
50	A: 0.82	CT3: ND (<0.042)	PD2: ND (<0.041)
225	B: 0.571	CT4: ND (<0.017)	PD3: ND (<0.018)
84	B: 0.029	CT5: ND (<0.050)	NS
34	B: 0.656	CT6: ND (<0.122)	PD4: ND (<0.119)
82	B: 0.623	CT7: ND (<0.051)	PD5: ND (<0.049)
25	B: 0.480	CT8: ND (<0.167)	PD6: ND (<0.162)

@ A: AMSCO
B: Baseline Industries, Inc.

*Charcoal Tube: CT
**3M Passive Monitor: PD

Note: ND = None Detected
NS = Not Sampled

Any direct reading method used for compliance monitoring would need to have the same response as the standard method.

IV. RECOMMENDATIONS

A. The continuous monitors should not be used for compliance monitoring. Personal exposure assessments should be made by using the OSHA acceptable sampling method described in 29 CFR 1910.1047, Ethylene Oxide(4).

B. Both continuous monitors responded by detecting EtO concentrations greater than the OSHA acceptable method. Either machine could be used as a screening or warning device.

C. If an organization is looking to use a direct-reading continuous EtO monitor to warn personnel of a sterilizer malfunction or a cylinder leak, where high levels of EtO is expected, a less sensitive low cost monitor should be considered.

References

1. AFOEHL/ECH letter to HQ AF/SGPA, 29 Nov 1988, Evaluation of Ethylene Oxide (EtO) Alarm Instrumentation.
2. National Institute for Occupational Safety and Health: Ethylene Oxide, Method 1607. NIOSH Manual of Analytical Methods, Third Edition, DHHS (NIOSH) Publication No. 84-100 (1984).
3. National Institute for Occupational Safety and Health: Ethylene Oxide, Method 1614. August 1987 Supplement to the NIOSH Manual of Analytical Methods, Third Edition, DHHS (NIOSH) Publication No. 84-100 (1984).
4. U.S. Department of Labor, Occupational Safety and Health Administration: 29 CFR CFR Part 1910 Occupational Exposure to Ethylene Oxide. Fed. Reg. 49(122):25734 (June 22,1984).

Distribution List

	Copies
HQ USAF/SGPA Bolling AFB DC 20332-6188	1
HQ AFSC/SGPB Andrews AFB DC 20334-5000	1
HQ ATC/SGPB Randolph AFB TX 78150-5001	1
HQ HSD/XAE Brooks AFB TX 78235-5000	1
Wilford Hall USAF Medical Center/SGLP Lackland AFB TX 78236-5300	2
Wilford Hall USAF Medical Center/SGKFE Lackland AFB TX 78236-5300	1
USAF Regional Medical Center Wiesbaden/SGB APO New York 09220-5300	1
OL AD, AFOEHL APO San Francisco 96274-5000	1
Defense Technical Information Center (DTIC) Cameron Station Alexandria VA 22304-6145	2
USAFSAM/TSK Brooks AFB TX 78235-5301	1
USAFSAM/EDH Brooks AFB TX 78235-5301	1